



Fragment Analysis for the JTAPIC Program

National Test and Evaluation Conference March 2011

Warfighter Survivability Branch

Karen Pizzolato

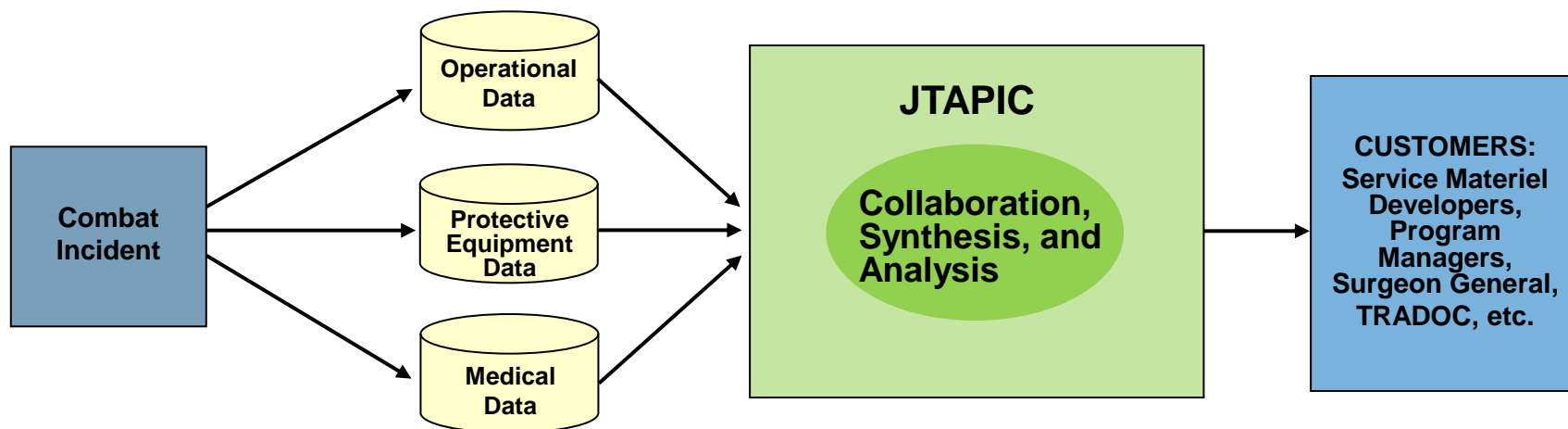


TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Survivability/Lethality Analysis Directorate
Army Research Laboratory

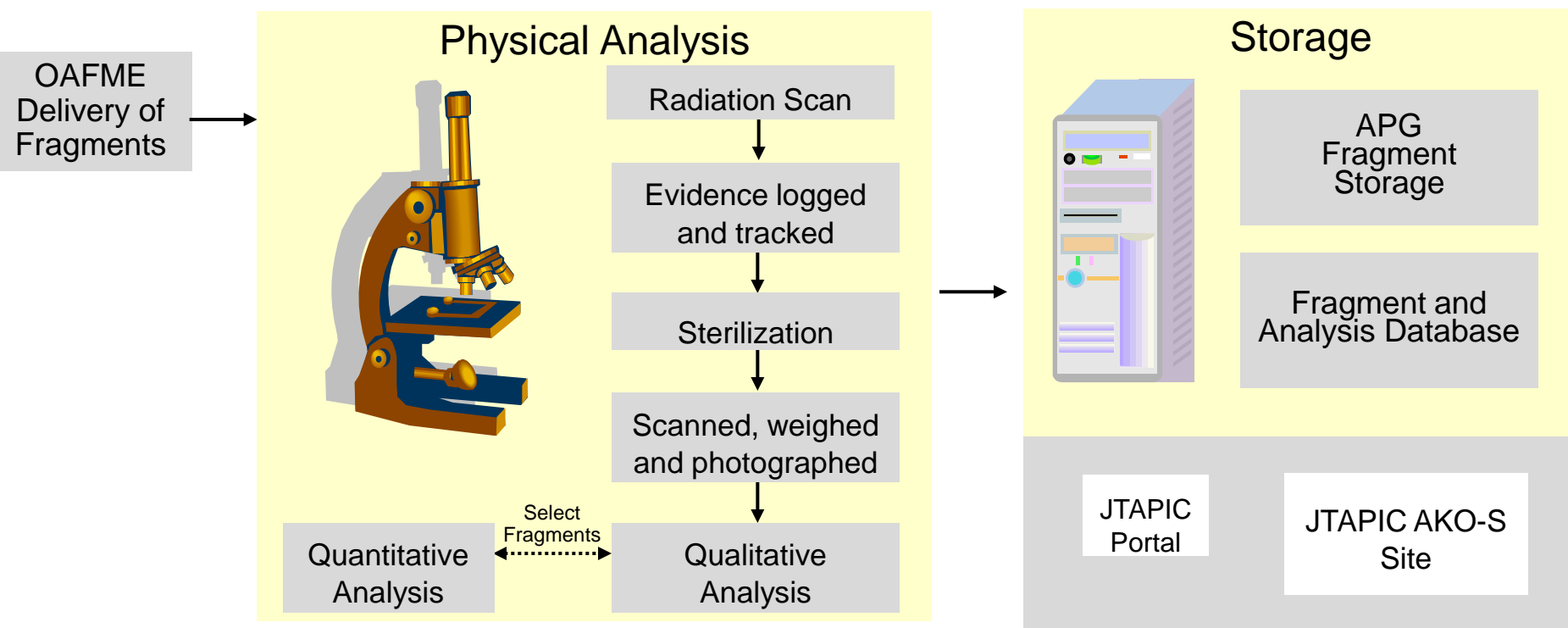
Acknowledgements: Barbara Wolfe, Daniel Snoha, Brad Klotz, and Lars Piehler

What is JTAPIC?



The Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) program links the medical, intelligence, operational, and materiel communities in collecting, analyzing, and integrating data from combat incidents to inform decisions by materiel developers, commanders, Training and Doctrine Command (TRADOC), and senior leaders to improve Warfighter survivability.

Fragment Processing



Recorded Fragment Information

Mass: 2.25 g

Dimension: 12.7 × 10.3 × 3.2 mm

Density: 7.11 g/mL

Shape: Irregular

Recovery Location: Neck (pharynx)

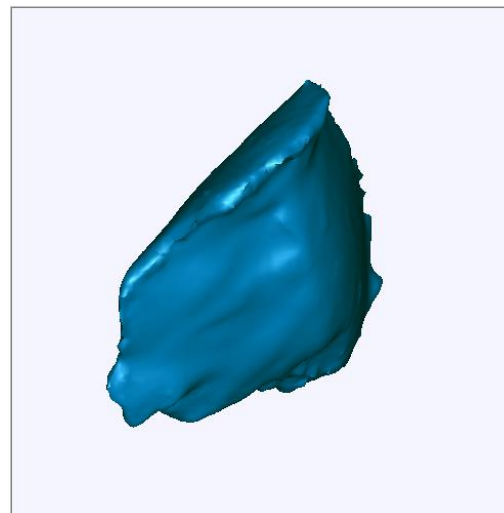
Description: Smooth copper color. Top concave side has cut marks. Appears to be a fiber-like material attached to fragment. Specimen cut for analysis.

Predominant Materials: Copper and Iron

Photo



3-D Scan

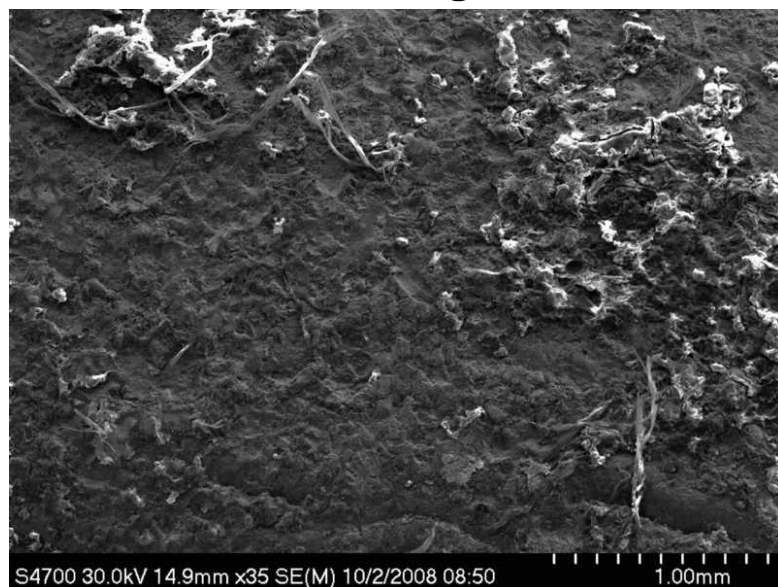


SEM-EDS Fragment Characterization

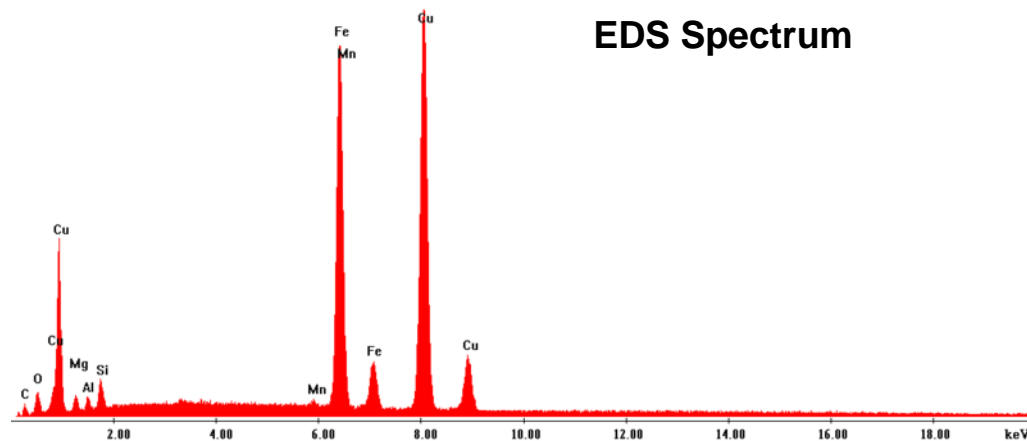
Scanning Electron Microscopy- Energy Dispersive X-ray Spectroscopy (SEM-EDS) is an analytical technique used to determine the elemental composition of a given sample.

- Elemental results are specific to the nature of the sample and the surface area scanned.
- EDS provides a first approach, qualitative assessment of fragment material.

SEM Image



EDS Spectrum



Inductively Couple Plasma- Atomic Emission Spectroscopy (ICP-AES) is a quantitative, analytical technique used to determine the elemental composition of a given sample.

- Metals in trace amounts can be detected.
- Exact elemental concentrations and metal alloys can be determined.





Photograph Courtesy of Image from Lehigh Testing Laboratories, Inc.
(www.lehightesting.com), used without permission

ICP-AES Sample Results

Case ID #	
Chemical Element	Percent of Total (%)
Carbon	0.46
Sulfur	0.024
Manganese	0.54
Silicon	.025
Chromium	0.39
Nickel	0.10
Phosphorus	0.009
Copper	0.16
Molybdenum	0.01
Cobalt	0.006
Aluminum	<0.002
Lead	<0.001
Vanadium	0.002
Iron	98.049


Fragment Detail Information


JTAPIC Fragment and Material Database


[JTAPIC Database](#)
[Logout > Main Page > Case Lookup > Case Detail > Frag Detail](#)

Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) Fragment and Material Database

Distribution is limited to U.S. Government agencies and their contractors; critical technology (Jan 2009), and redistribution is prohibited without the explicit permission of Director, U.S. Army Research Laboratory, ATTN: RDRL-SLB-W, APG, MD 21005-5068 and the JTAPIC Program Management Office.




User:

Password:

[Change Password](#)

The JTAPIC program is a partnership within DoD involving several organizations. The goal of the JTAPIC program is to improve the understanding of our vulnerabilities and to develop solutions that will prevent or mitigate battlefield-related injuries. The JTAPIC program integrates operational, intelligence, materiel and medical data to establish a framework for collaborative multi-community analysis. The JTAPIC community is focused on providing actionable information to improve Warfighter survivability.

The program collects and analyzes data in order to warn commanders of vulnerabilities from threat-target pairings and to provide actionable information to assist vehicle equipment and materiel development in order to better protect Warfighters from battlefield threats. This database is one of the important artifacts of the program. It is a data repository for materiel evidence and unknown materials that are of interest to the program. Materials are received by ARL for further analysis which include metallurgical identification and may include reverse engineering and modeling of threat and target characteristics and injury analysis. Information in the database is used in conjunction with various data sources to support a detailed understanding of battlefield vulnerabilities.



U.S. Army Research Laboratory
Survivability and Lethality Analysis Directorate

Fragment sections made from this Fragment

Fragment Section Number



Main Page


JTAPIC Fragment and Material Database


[JTAPIC Database](#)
[Logout > Main Page](#)

JTAPIC Database
Last Modified: 2009-11-10 12:49:11

Main Page

JTAPIC Data

Search, Edit, Add, Delete

- [Events](#)
- [Cases](#)

JTAPIC Reports

Report on a single case	Filter Report By Dates (YYYY-MM-DD) and/or Provider			
<input type="text"/>	Start Date: <input type="text"/>	End Date: <input type="text"/>	Provider: <input type="text"/>	<input type="button" value="All Providers"/>

- [Case Summary](#)
- [Fragment Custody](#)
- [Fragment Action](#)
- [Fragment Action Sequence](#)
- [Fragment Brief](#)
- [Fragment Brief List](#)
- [Fragment Body Location](#)
- [EDS Metallurgy Detailed](#)
- [EDS Metallurgy Statistics](#)
- [EDS Metallurgy Occurrence](#)

- [Source Summary](#)

JTAPIC Database Reporting

Database Reporting

Fragment Brief Report

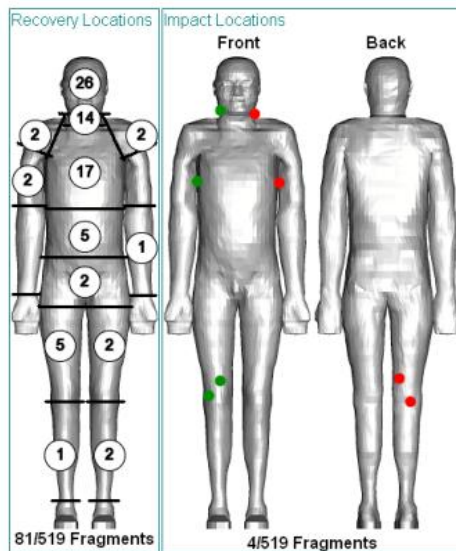
Generated: 2010-01-21, 122 cases, 822 fragments

JTAPIC Database

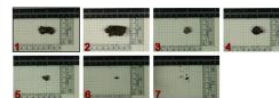
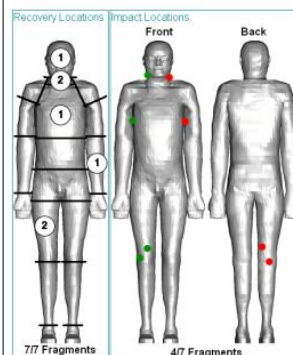
For Official Use Only

Fragment Body Location Report

Provider: OAFME



Case:

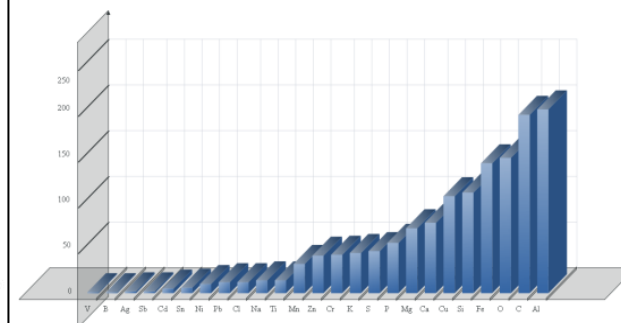


Fragments Recovered in this Case									
Frag Number	Mass (g)	Length (mm)	Width (mm)	Depth (mm)	Density (g/cc)	Shape factor	Recovery location (detail)	Predominate element	Predominate element %
1	8.34	30.64	15.88	7.94			Right femur	Iron	78.35
2	18.80	41.27	20.64	6.35			Right thigh	Iron	74.64
3	2.25	12.70	10.32	3.17			Pharynx	Copper	56.46
4	5.80	19.05	17.46	5.56			Nose	Iron	88.19
5	1.53	12.70	10.00	4.76			Left lower arm	Iron	57.17
6	0.01	1.59	2.38	0.48			Pharynx	Carbon	76.68
7	0.23	6.35	3.17	2.38			Right lung lobe	Copper	61.95

Identifier	
Mass (g)	32.31
Predominant Elemental Composition	Iron Carbon Chromium

Element Occurrence in 232 Tested Fragments

Provider: OAFME

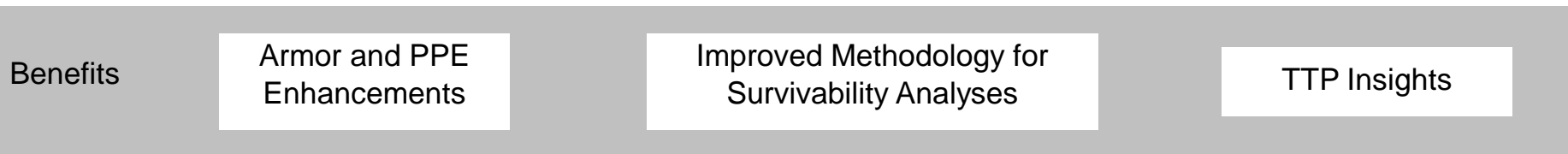
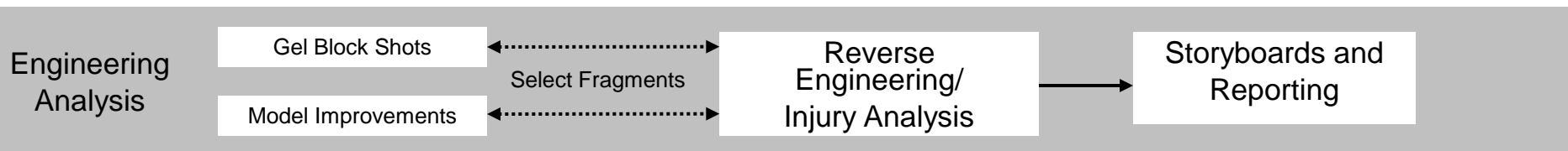
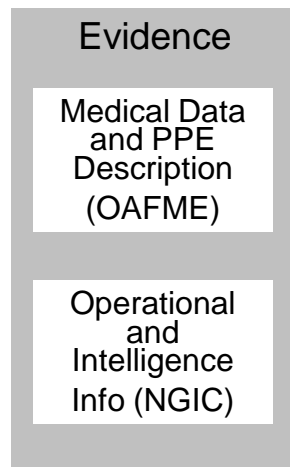


Element Occurrence					
Aluminum	201	Magnesium	71	Titanium	14
Carbon	195	Phosphorus	55	Sodium	14
Oxygen	148	Sulphur	46	Chlorine	12
Iron	142	Potassium	44	Lead	12
Silicon	110	Chromium	42	Nickel	10
Copper	106	Zinc	41	Tin	6
Calcium	77	Manganese	32	Cadmium	5

Identifier	
Mass (g)	0.71
Predominant Elemental Composition	Iron Carbon Oxygen
Dimensions (l x w x d mm)	9.53 x 7.94 x 0.00 mm

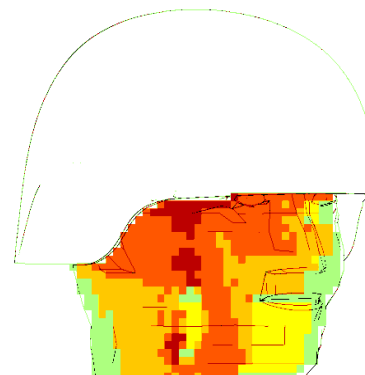
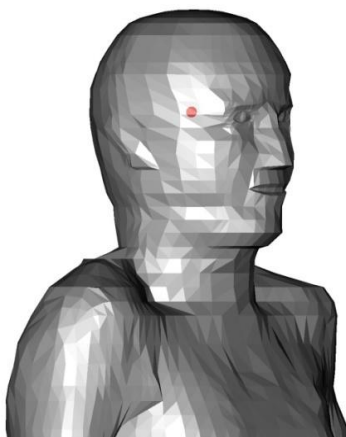
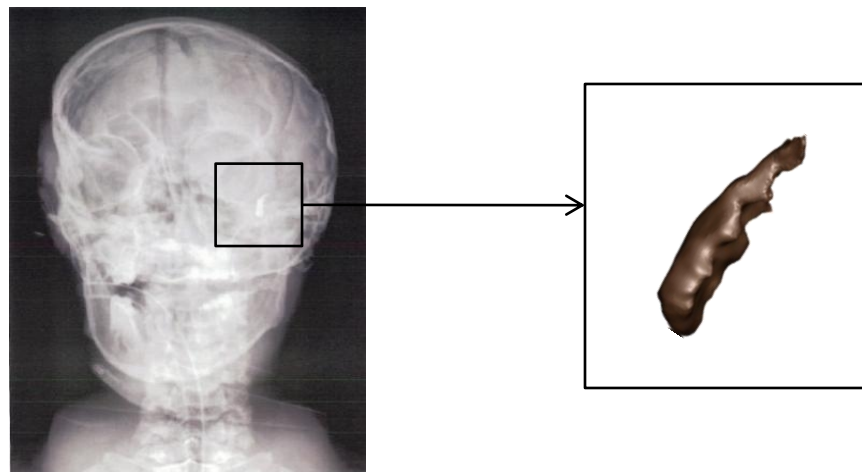
Composition	Iron Aluminum
Dimensions (l x w x d mm)	59.53 x 44.45 x 20.64 mm

Incorporation of Fragment Analyses



Example of Event Recreation Using Modeling and Simulation

ARL combines fragment information with the operational intelligence and medical data received from the other JTAPIC partners to analyze and recreate events of interest using modeling and simulation (M&S).



New Capabilities

- Analyzing plastic fragments to identify plasticizer and polymer compounds
- Providing support to Health Affairs for embedded, toxic fragments
- Matching fragments to anatomical hit locations
- Identifying fragment source to assist the material development community in identifying threat materials
- Analyzing fragment masses to assist the material development community with threat identification and testing designs

Future Efforts

- Match hit locations to body armor placement
- Improve visualizations in database to replicate existing prototypes
- Develop a classified database in order to incorporate operational intelligence information, medical data, and fragment analysis results in one location

Karen Pizzolato

U.S. Army Research Laboratory

Temporary Assignment, Armed Forces Medical Examiner System

Phone: 410-278-4102

Email: karen.pizzolato@us.army.mil or karen.pizzolato@us.af.mil